Name: _____   Date: _____

s19 Matrix Exam (solution v118)

Let the 2×4 matrix U represent four points in the xy-plane (so each column represents a point). When those four points are connected as a convex polygon, matrix U represents a unit square. Also, let the 2×2 matrix L represent a linear transformation.

$$U \;=\; \begin{bmatrix} 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \end{bmatrix} \qquad L = \begin{bmatrix} 9 & 1 \\ 7 & 2 \end{bmatrix}$$

Let matrix $P = L \cdot U$, so P is found by matrix multiplication of L times U. Matrix P also represents 4 points of a polygon. Use the diagram below to calculate the elements of P. Then, draw the polygon represented by matrix P on the xy-plane below. Notice I have already drawn the unit square represented by matrix U.

1. Multiply $L \cdot U$ and draw resulting polygon.
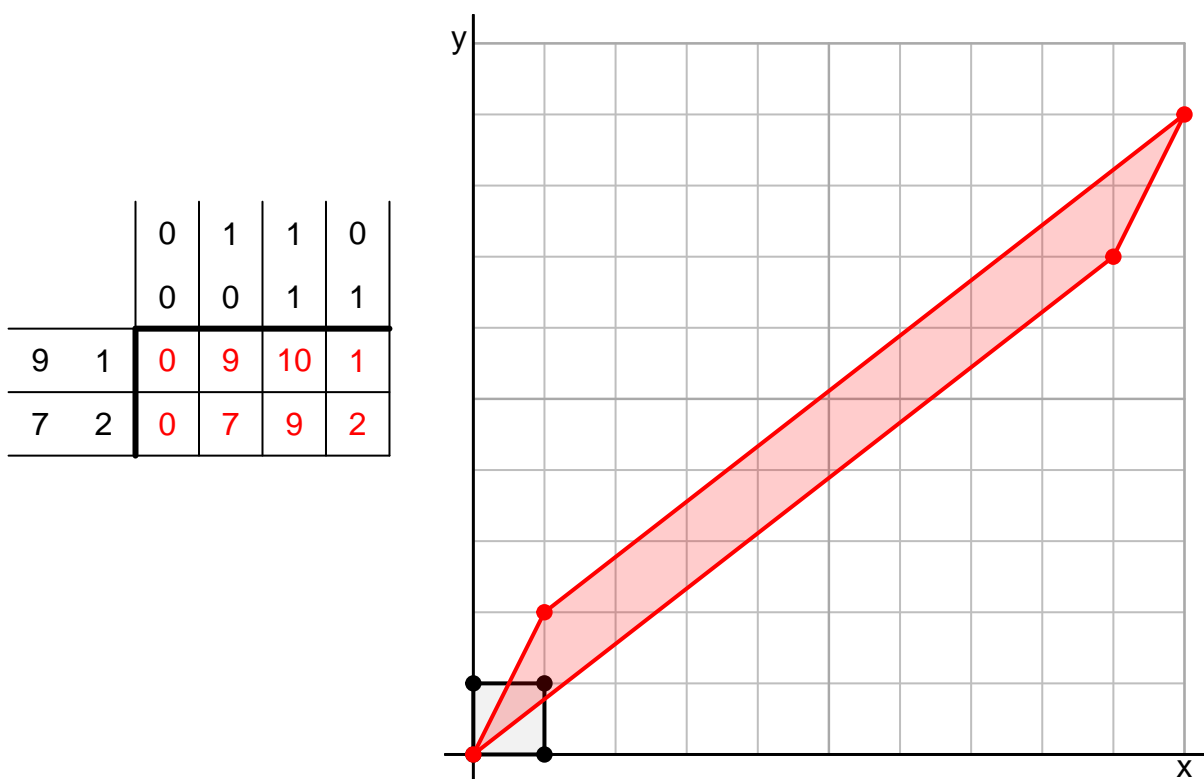
2. What is the area of the convex polygon represented by matrix P? *Hint: the area equals the absolute value of the determinant of matrix L.*

$$\text{area} \;=\; \det(L) \;=\; (9 \cdot 2) - (1 \cdot 7)$$

$$\text{area} \;=\; 11$$

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The triangle shown below is composed of the three points represented by matrix $A = \begin{bmatrix} 10 & 5 & 5 \\ 5 & 5 & 10 \end{bmatrix}$. In order to reflect over the x axis and then rotate by $306.87°$ counterclockwise we can multiply by the transformation matrix $R = \begin{bmatrix} 0.6 & -0.8 \\ -0.8 & -0.6 \end{bmatrix}$.

3. Calculate the matrix $R \cdot A$.

$$R \cdot A = \begin{bmatrix} 2 & -1 & -5 \\ -11 & -7 & -10 \end{bmatrix}$$

4. Draw the triangle represented by $R \cdot A$.